FOOD PROCESSING, A NECESSITY FOR THE MODERN WORLD IN THE CONTEXT OF FOOD SAFETY: A REVIEW

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ABSTRACT

Având în vedere creșterea demografică explozivă la nivel mondial, alimentele procesate au devenit indispensabile pentru hrana zilnică a consumatorilor. Hrănirea unei populaţii mondiale în continuă creştere este o provocare globală majoră, care constă în creşterea productivităţii agricole, garantarea accesului la alimentaţie al tuturor indivizilor, dar, în același timp, asigurarea siguranței alimentare pentru consumatori. Tehnologiile moderne de procesare se bazează pe anumite principii biotehnologice ce vizează obţinerea de produse alimentare sigure pentru consum, prin eliminarea agenților patogeni din hrana procesată, într-un mod durabil din punct de vedere social şi economic.

Realitatea este că multe alimente procesate sunt prelucrate excesiv și conțin cantități mai mari de calorii, grăsimi, zahăr, sare și aditivi chimici. Dar nu este mai puțin adevărat că există o mulțime de alimente minim procesate, sănătoase și hrănitoare. De aceea, pentru a avea o viață sănătoasă, consumatorul este cel care trebuie să facă alegerile corecte cu privire la alimentele consumate. Într-o viață activă, alimentele procesate sunt soluția cea mai la îndemână; din acest punct de vedere, procesatorii ar trebui să se concentreze pe produse „curate" și sănătoase.

Lucrarea de față punctează câteva aspecte legate de necesitatea actuală a procesării alimentelor, pentru ca acestea să fie mai sigure pentru consum, mai accesibile, cu calități nutritive îmbunătățite și care să dispună de un echilibru corespunzător între ingrediente și nutrienții pe care îi furnizează.

Given the global explosive demographic increase, the processed foods have become indispensable for the daily nutrition of consumers. The feeding a growing world population is a major global challenge, which consists to increase agricultural productivity, guarantee access to food for all individuals, and at the same time ensure food security for consumers. The modern processing technologies are based on certain biotechnological principles that aim at obtaining safe food for consumption by removing pathogens from processed food in a socially and economically sustainable manner.

The reality is that many processed foods are excessively processed and contain higher amounts of calories, fat, sugar, salt and chemical additives. But it is no less true that there is a lot of minimally processed foods healthy and nutritious. That is why, in order to have a healthy life, it is up to the consumer to make the right choices about the foods consumed. In an active life, processed foods are the handiest solution; from this point of view, processors should focus on "clean" and healthy products.

This paper highlights some aspects of the current necessity for food processing to make them more safer for consumption, more accessible, improved nutrition and having an adequate balance between the ingredients and the nutrients they provide.

INTRODUCTION

Food processing dates back to the prehistoric ages, about two million years ago; at that moment, the empirical processing of food consisted of fermenting, sun drying, preserving with salt, and various types of cooking. Such basic food processing involved

chemical enzymatic changes to the basic structure of food in its natural form, as well served to build a barrier against surface microbial activity [16]. All these methods have evolved over time, with the food industry discovering many techniques to process natural products to be safer for consumption, more accessible, more nutritious, or simply more appetizing. In the face of the demographic explosion, it is essential that agriculture and the food industry find the balance between food production, energy production and resource conservation, while satisfying consumer demand. The consumer needs a favourable living environment, unpolluted but in equal measure he needs healthy food. From this point of view, a safe, tasty, nutritious and long-term food is processed food.

The concept of safe and nutritious food encompasses a multitude of different elements. It is a food that contains all the nutrients and biologically active substances which consumer needs to maintain his health. Also, the concept of safe food refers to that food free from toxins, pesticides, chemical, physical and bacterial contaminants such as bacteria and viruses that can affect the consumer health. In support of guarantee food safety, HACCP (Hazard Analysis Critical Control Point) is a systematic approach to ensuring food innocuity, based on identifying, evaluating and keeping under control all risks that might occur in the manufacturing, handling and distribution process. The HACCP principles must be apply to the entire production chain, starting from the production, processing and final product, purchased by the consumer.

Security and food safety are part of the state policy of every country in the world. Processed foods are defined by nutritionists as deliberately processed food before it is consumed for safety reasons. Processing methods include preservation, freezing, refrigeration, dehydration, and aseptic processing. Food traceability must be established at all stages of production, starting with primary production, processing, storage and distribution.

MATERIALS AND METHODS

This review focuses on the importance of food processing for the modern society, given the increasing number of consumers globally, in the context of ensuring food safety, i.e. their lack of toxicity for consumer. For this purpose, the newest trends in the modern food processing are briefly presented, indicating the advantages of each method.

For this study, has been consulted the specialized literature but also some web sites. In literature, most studies on modern processed food technologies focus on microbial safety, extended shelf-life, nutrient retention, and quality preservation of foods.

RESULTS

According to the results of the 2017 Revision, the world's population numbered nearly 7.6 billion as of mid-2017, implying that the world has added approximately one billion inhabitants over the last twelve years. The world is projected to hold 9.6 billion people by 2050 [26]. The world will have to close a gap of nearly 70% between the amount of food available today and that required by 2050 [24].

Demographic growth automatically involves ensuring food security and increases of agricultural output. From this point of view, all technological steps are very important and among this, fertilization has a major role. In fact, the usage of fertilizers with foliar application became part of modern technologies of plant culture. It is one of the important technological links to help crops make full use of their genetic potential [9]. In the same vein, the nitrogen fertilization and seed rate depth have a positive effect on the yield and its constituents [6].

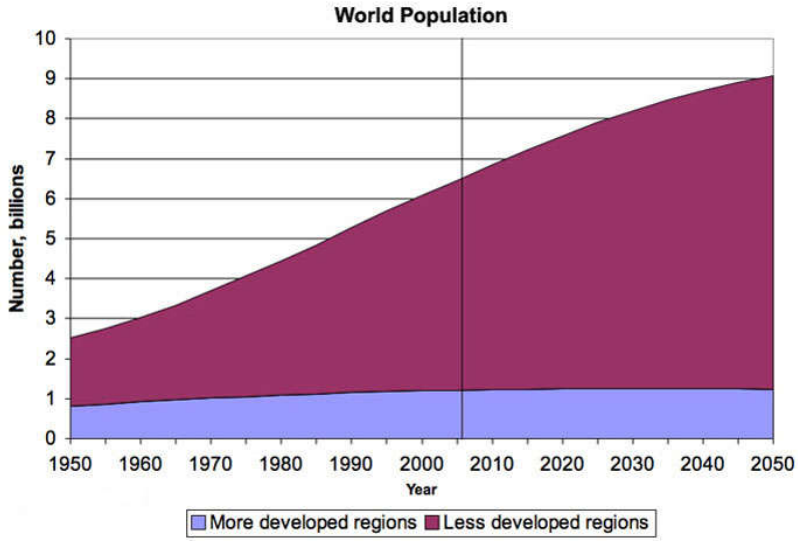

Figure 1. World Population Prospects [26]

The paradox is that although the number of people globally is increasing and food resources declining, however a lot of food is being thrown away. From this point of view, losses across the entire food circuit are pretty much the same in most countries. However, they often differ in different stages of processing in the food industry but also by living standards. While in richer countries almost half of the food is thrown by the end consumer, in poorer countries food waste is reduced because people cherish the food. The losses during harvesting, storage or processing are higher where inefficient and out-dated technologies or deficient knowhow exist. From the point of view of food waste, there is currently no study done on a scale of more than 1 million people. The most recent figures are based on surveys and estimates of food production units. They are supplemented with literature values. At present, large-scale research is being carried out [17].

Food safety is essential for consumer health. It consists of observing the sanitary norms in the production process and aims at guaranteeing the health of the population through the consumption of safe foods, in terms of sanitation, freshness and nutritional value. The defining elements for food safety are the following: the quality of the raw materials entering the manufacturing process; the food production process; storage and transport of food; as well as conditions of food marketing. The modern technologies for vegetal production processing take into account the increased interest of consumers in healthy and affordable food, but also the demands of society for sustainable agricultural development, as well as the multitude of favourable effects on the environment.

In the Nielsen's Global Health & Wellness Survey (2015), nearly half (49%) of global respondents consider themselves overweight, and a similar percentage (50%) is actively trying to lose weight. And they're doing so by making more healthful food choices, with help from food and beverage companies. These companies offer food products reformulating from which were removed or reduced the sugar, cholesterol, trans and saturated fat and sodium content, introducing products high in desirable attributes like fibber and protein. From this point of view, there is a great opportunity for food manufacturers and retailers to lead a healthy movement by providing the products and services that consumers want and need [22].

Food processing is the set of methods and techniques used to transform raw ingredients into food or to transform food into other forms for consumption by humans [5]. Food production (as well as the quality of the raw material, such as maize) in any given year is affected most directly by the values of the critical climate elements (temperature, radiation, precipitation, etc.) during the year [2]. For example, in Romania and especially in

Oltenia region, drought is one of the major problems that affect crops [3]. The stability of available food supplies is governed by the interannual variability of these elements.

The modern processing for food refers to membrane technology, super-critical fluid technology, and some applications of biotechnology, mainly applied to obtain functional foods, "all-natural" enriched foods, probiotics and prebiotics [13]. For today's modern world, food processing has become more than a necessity. From this point of view, there are several advantages: processed foods are usually less susceptible to early deterioration than fresh foods; their preservation can be done for a long time without losing their nutritional and tasting qualities; resists better distance transport from source to consumer, etc. Without processing, the food it begins to deteriorate immediately due to the following factors: microorganisms; intrinsic enzymes; temperature; moisture, etc. Because of the risk of spoilage, much of our food it must processed to increase its availability. A food is considered preserved once it is stabilized with respect to safety and quality. No type of food processing can transform poor quality raw materials into good ones, but can increase the product's shelf life. Therefore, in order to obtain a quality processed food, the raw material must be of a high quality.

Consumers want foods that are quick or ready for immediate consumption, but also fresh and nutritious, such as bag salads, and single portion prepared fruits and vegetables – as well as foods that can replace certain meals, such as breakfast bars. Consumers also want more information in order to ensure that their buying habits align with their personal values (such as animal welfare, vegetarian, halal, kosher, and fair trade). The "clean label" approach, which focuses on fewer and more natural ingredients and includes claims such as no additives, no preservatives, and no artificial flavours or colours, has evolved into "clear label" positioning which embraces the concept of transparency [19].

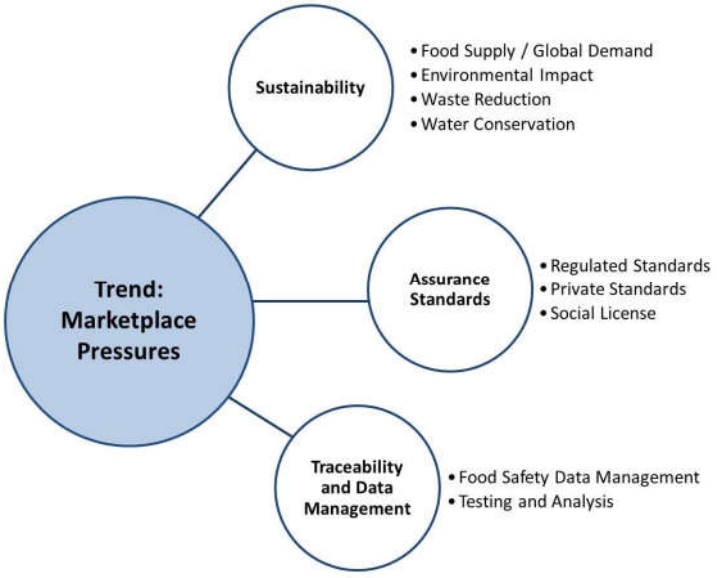

Figure 2. Three factors of the Marketplace Pressures trend [19]

Price and taste have long been the most important decision factors for the majority of consumers when choosing food. Another factors driving consumer preferences that can influence new product development and product acceptance is: shifting demographics, convenience, environmental stewardship, and desire for more information about food. From this point of view, the diagram below showing three driving factors of the Marketplace Pressures trend: Sustainability (food supply/global demand, environmental impact, waste reduction, water conservation); Assurance Standards (regulated standards,

private standards, social license); Traceability and Data Management (food safety data management, testing and analysis) [19].

The modern technologies define modern food production. Modern food processing has three major aims: to make food safe (microbiologically, chemically); to provide products of the highest quality (flavour, colour, texture) and to make food into forms that is convenient (ease of use). The food safety has become a top concern for many countries and governments, which has made by the food safety a top priority. The globalization of food supply, the better ability to detect food safety issues, and increased the global demand for food all lead to a necessity to processing more and more food.

In modern times, it has become necessary to replace the established methods of food processing with alternative methods. From this point of view, alternative food preservation technologies include methods that reduction of energy consumption. While conventional processes primarily utilize thermal energy, advanced processes utilize mechanical, electromagnetic, light, electrical, and other forms of energy to accelerate reactions, such as inactivation of microorganisms. High-pressure processing (HPP), membrane filtration (MF), pulsed electric fields (PEF), and ultraviolet radiation (UV) are examples of alternative preservation technologies of growing commercial interest. As unit operations these technologies operate in 4 modes of energy transfer: momentum, heat, electromagnetic, or photon transfer [7, 8].

Four major areas in food production may benefit from nanotechnology: development of new functional materials, microscale and nanoscale processing, product development, and methods and instrumentation design for improved food safety and biosecurity [21].

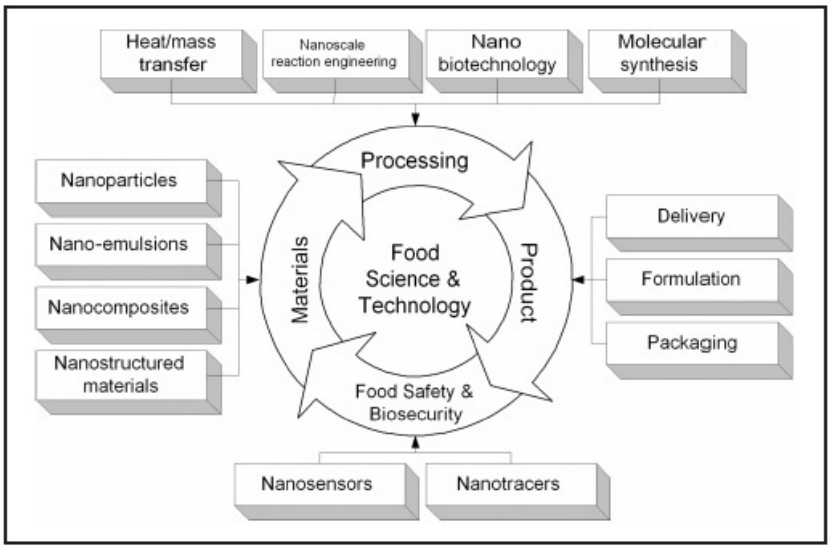

Figure 3. The main applications of nanotechnology in food science [21]

The conventional methods of food processing/preservation are well known (sterilization, pasteurization, refrigeration, etc.). Along with these, some modern food processing methods and their advantages are given below.

Evaporation is the partial removal of water from liquid foods. When the operation is done under vacuum, the food's flavour qualities are retained. Examples of processed vacuum evaporation foods are milk, tomato paste and juice concentrates. Advantages of evaporation under vacuum: to reduce the weight and, therefore, reduce storage and transport costs; to preserve foods by decreasing the water activity and increasing the solids content and to provide consumers with convenient and qualitative foods.

Extrusion is the process which provides a greater variety of textured foods to consumers: confectionery products (chocolate, candies and biscuits), food products for

children and dietetic food, a wide range of pasta, etc. The main advantages of the food processing by extrusion are: increasing assimilability; reducing the microbiological contamination of products; reducing environmental pollution; obtaining ready-to-eat products; intensification of the production process; reducing production costs (heat consumption, electricity); expanding the range of food products, etc.

The digestion of man from the point of view of physiology is based on the mechanical destruction of food products and their subsequent processing with acids and ferments and transformation of the compound into simpler substances, accompanied by considerable physiological energy expenditure. For this reason, extruded products can eliminate a number of problems, especially in people who suffer from certain diseases [15].

A modern technology for vegetarian food processing is *PowerHeater technology*. The PowerHeater process is based upon transferring mechanical and thermal energy into a mix/emulsion in order to coagulate the protein and potential sources of carbohydrates. The technology enables vegetable based formulas to be transferred into a much texturized meat-alike product. Advantages when using texturized PowerHeater products: meat alike texture (if required); increased protein content achievable; less need for carbohydrates as binding agent; low production costs; enhanced texture of the final product; a better taste [18].

Pulsed electric field (PEF) has received considerable attention due to its potential to improve food quality or to create alternatives to conventional methods of processing. This processing method helps to obtain processed foods or fruit juices safely, with sensory nutritional properties of freshness. The studies presented in the scientific literature show that the use of various waveforms of the electric current contributes to the inactivation of microorganisms, to the disruption of the cellular material [1]. The effect of PEF can be used to increase the efficacy of extraction of various bioactive compounds. However, despite commercial success, there are still many unknown factors associated with PEF processing of fruit and citrus juices and many contradictory reports in the literature [25].

Thermal processing generally it means the transfer of heat energy using conduction, convection, or radiation [14]. Some food processing technologies involve combinations of these modes of heat transfer. Most often conduction and convection are the predominant ones in food thermal processing applications. The microbial reduction effectiveness of the treatment depends on the process temperature and treatment time. The food environment also affects the outcomes because it can work as a temperature conductor or insulator [4]. Traditionally, thermal-based food processes are often well optimized to recover a significant part of the energy. However, due to the emerging nature of alternative food preservation technologies, very limited efforts have been made yet to develop such energy recovery approaches [8].

All the advantages of modern processing of food are indisputable. In this regard, the benefits of processed foods are: save time, labour and fuel, little cooking skill needed, less waste, often fortified, easily stored, wide variety, increase shelf-life, ensure wide choice all year round. There are, however, some disadvantages that need to be mentioned: decreased of some nutritional qualities, more expensive, contain additives, sometimes low content in fibre, and high in salt, sugar and fat. For example, any processing of food can have slight effects on its nutritional density. Vitamin C is destroyed by heat and therefore canned fruits have a lower content of vitamin C than fresh ones.

There are a number of ways we can conserve Vitamin C in large quantities in the products, in which it can be found, and one of them could be freezing [10]. A USDA* study in 2004 indicates that, in the majority of foods, processing reduces nutrients by a minimal amount. In fact, on average any given nutrient may be reduced by as little as 5%-20% [20]. In the same vein, another safety concern in food processing is the use of food additives. By adding some sweeteners, food colouring or

preservatives, food products with a higher sensitive quality but also with a higher risk potential for consumers with certain health problems are obtained [11]. In the European Union, only food additives that have been approved as safe for human consumption by the European Food Safety Authority (EFSA) are allowed, at specified levels, for use in food products [23]. It is very important to study the biochemical and electrochemical processes in order to establish the best food additives – according to the best risk management concerning the consumer's health and to improve the consumer's trust for final products alimentary safety [12].

Toxicology of food additives safety is continuous evaluated. The risk from an additive must be minimal and must be balanced against the benefits of their use. This aspect it should never be neglected by processors. Therefore, food processors must choose the most appropriate method of processing, taking into account food safety for the consumer, along with improving or maintaining the nutritional and sensorial quality of the food product, and additionally, lowering energy consumption and eliminating amounts waste for to ensure the environmental protection. The reality is this: many processed foods are overly processed and contain higher amounts of calories, fat, sugar, salt and chemical additives. But not all processed foods are unhealthy. In fact, there are plenty of processed foods that are healthy and nutritious. Thus, although all dairy foods are processed (milk, cheese, yogurt, etc.), they offer a lot of health benefits: they're a great source of protein, calcium, Vitamin D and potassium. Also, pre-cooked brown rice, quinoa or wild rice they are processed, but not in a negative way.

In order to have a healthy life, it is up to the consumer to make the right choices about the foods consumed. In an active life, processed foods are the handiest solution, but this is about healthy processed foods. To make the right choices for his personal health and comfort, the consumer has to identify those healthy processed foods, taking into account some basic rules, as follows: reading the food labels; selecting minimally processed fruits and vegetables; choosing whole grains with few additives, etc. It can be said with certainty that the diet is the key to personal health and the health of the planet.

CONCLUSIONS

The food safety has become a top concern and a top priority for many countries and governments. The globalization of food supply, the better ability to detect food safety issues, and increased the global demand for food all lead to a necessity to processing more and more food. Today, in the century of speed, consumers expect food to be immediately available, tasty and nutritious, safe for consumption, not to endanger their health and have a reasonable shelf life. In an active life, processed foods are the handiest solution, but this is about healthy processed foods. From this point of view, the processors should focus on clean and healthy products.

The modern food processing technologies can not only improve nutrition and sensorial quality of foods but can also contribute to an improved sustainability of the food manufacturing sector from the point of view of environmental protection. However, in modern food processing, processors need to choose a particular technology only after considering a number of factors, of which the most important are food safety, nutritional benefits, and low energy consumption.

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